

Magnetoelectric Devices and Methods of Using Same

Existing magnetoelectric materials relying on the use of metallic or ceramic magnetostrictive materials and ceramic piezoelectric materials as their constituent phases may have three problems. First, the operational frequency may be limited to a few kilohertz due to the presence of eddy-current losses in the metallic magnetostrictive phase. Secondly, it may be difficult to machine and fabricate devices due to the mechanical brittleness of the ceramic and some metallic magnetostrictive phases as well as of the ceramic piezoelectric phase. Thirdly, it may be difficult to tailor and optimize the properties (i.e., magnetoelectric voltage coefficient α_E , etc.) of the devices due to the limitation of the types of the constituent materials. This invention provides a magnetoelectric element including at least one set of alternative piezoelectric layer and magnetostrictive composite layer. The magnetostrictive composite layer includes at least one magnetostrictive material dispersed in first concentrated zones within a first polymer matrix, wherein all of said concentrated zones are orientated along a first direction. It is found that the conversion efficiency (i.e., α_E) varies in accordance with applied magnetic control field $H_{Control}$ in magnetoelectric devices made of such a magnetoelectric element.